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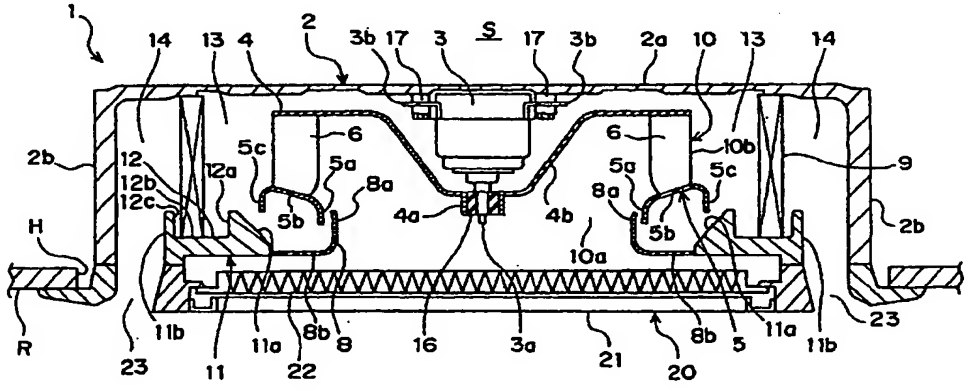
(54) AIR CONDITIONER

(57) The air conditioner of the present invention is equipped, within a casing 2, with a cylindrical bell mouth 8 for introducing room air, a centrifugal fan 10 for radially blowing off air sucked in through the bell mouth 8, and a heat exchanger 9 provided opposite to an air outlet 10b of the centrifugal fan 10. A shroud 5 of the centrifugal fan 10 has an annular guide portion 5c which is provided radially outside the blade support portion 5b and which abuts on an annular blade support portion 5b and extends toward the suction side in the axial direction. By virtue of this guide portion 5c, air blow noise can be reduced effectively.

Fig. 1



EP 0 926 452 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an air conditioner. More specifically, the invention relates to an air conditioner comprising a cylindrical bell mouth for introducing room air, a centrifugal fan for radially blowing off air that has been sucked in through this bell mouth, and a heat exchanger for performing heating or heat-absorption with the air that has been blown off by this centrifugal fan.

BACKGROUND ART

[0002] As shown in Fig. 4, as this type of air conditioner 101, there has been known one which comprises, within a casing 102, a bell mouth 108 for introducing room air, a centrifugal fan 110 for radially blowing off air that has been sucked in through this bell mouth 108, and a heat exchanger 109 provided opposite to an air outlet of this centrifugal fan 110. In this example, the casing 102, which is housed in a ceiling pocket S through an opening H provided in a ceiling R, has, along the ceiling R, a dressing panel 120 including a suction grille 122 and a grille fitting frame 121. On the rear side of the dressing panel 120, is provided an inner frame 111 having a conical-surfaced inner peripheral surface 111a opened toward a casing top plate 102a and an outer peripheral surface 111b comprising four planes forming the four sides. In the top face of the inner frame 111, is formed a receiving groove (drain groove) 112 comprising a flat bottom face 112b, an annular inner side face 112a extending along the inner peripheral surface 111a, and an outer side face 112c comprising four planes along the outer peripheral surface 111b.

[0003] The bell mouth 108 is formed into a cylindrical shape by boring a circular hole in the center of a partitioning plate 108b and besides curving an edge 108a of this circular hole toward the centrifugal fan 110. This bell mouth 108 is installed by fitting the partitioning plate 108b to an end portion of the inner frame 111 on the suction grille 122 side.

[0004] The centrifugal fan 110 has a main plate 104 placed along the casing top plate 102a, a shroud 105 opposed to the main plate 104, and a plurality of blades 106 provided between the main plate 104 and the shroud 105. In the center of the main plate 104, is provided a hub 104b of a truncated-cone shape curved toward the suction grille 122. A fan motor 103 is placed at a recess of the hub 104b on the casing top plate 102a side, and the main body of the fan motor 103 is mounted on the casing top plate 102a via an L-shaped flange 103b and a rubber isolator 117. Besides, an output shaft (rotary shaft) 103a of the fan motor 103 is mounted on the hub 104b via a rubber isolator 116. The shroud 105 has an annular blade support portion 105b that makes contact with the blades 106, and a cylindrical mouthpiece portion 105a curving from the inner edge of the blade support portion 105b and extending toward the suction side in the axial direction. This mouthpiece portion 105a overlaps with the cylindrical portion 108a of the bell mouth 108 to surround the outside of the cylindrical portion 108a with a spacing.

[0005] A fan guide 107 is set at the inner side face 112a of the receiving groove 112. This fan guide 107 comprises a cylindrical portion 107b to be fitted to the inner side face 112a, and a guide portion 107a curving from the upper end side of the cylindrical portion 107b and extending radially inward. This guide portion 107a is in proximity to the outer edge of the blade support portion 105b of the shroud 105. This arrangement allows air blown off by the centrifugal fan 110 to smoothly pass through a gap 113 between the centrifugal fan 110 and the heat exchanger 109.

[0006] The heat exchanger 109 is formed into a rectangular frame shape along the outer side face 112c of the receiving groove 112, and arranged so as to reach the casing top plate 102a from the bottom face 112b of the receiving groove 112.

[0007] In operation, the centrifugal fan 110 is rotated by the fan motor 103. As a result, room air is sucked to the centrifugal fan 110 through the suction grille 122 and the bell mouth 108, and then radially blown off by the blades 106 around the rotary shaft 103a. The blown-off air, while guided by the guide portion 107a of the fan guide 107, passes through the gap 113 between the centrifugal fan 110 and the heat exchanger 109, undergoing heating and heat absorption by the heat exchanger 109. Then, the air passes through a gap 114 between the heat exchanger 109 and a casing side plate 102b, thus being blown off into the room through an air outlet 123 of the dressing panel 120.

[0008] In such an air conditioner equipped with a centrifugal fan as described above, however, there has been a problem that the air blown off by the centrifugal fan 110 would cause air blow noise (foreign noise) of around 800 Hz (500 to 1000 Hz) at the gap 113 between the centrifugal fan 110 and the heat exchanger 109.

[0009] In this case, the guide portion 107a of the fan guide 107 is placed in proximity to the outer edge of the blade support portion 105b of the shroud 105 so that the air blown off by the centrifugal fan 110 smoothly passes through the gap 113 between the centrifugal fan 110 and the heat exchanger 109. However, the air blow noise can not be suppressed enough.

DISCLOSURE OF THE INVENTION

[0010] An object of the present invention is to provide an air conditioner which can effectively reduce the air blow noise.

[0011] In order to achieve the above object, the present invention provides an air conditioner comprising, within a casing, a cylindrical bell mouth for introducing room air, a centrifugal fan for radially blowing off air

sucked in through the bell mouth, and a heat exchanger provided opposite to an air outlet of the centrifugal fan, wherein

> a shroud of the centrifugal fan has an annular guide portion which is provided radially outside the annular blade support portion and which curves and extends toward a suction side in an axial direction.

[0012] According to this air conditioner, air blow noise (foreign noise of around 800 Hz) is effectively reduced as will be described later. Also, when the guide portion is provided integrally with the shroud, material cost, transport cost and installation cost for the fan guide are reduced so that the product cost can be reduced, as compared with the prior art.

[0013] In an embodiment, the centrifugal fan is made up by engaging the blade support portion with a fan body which is formed by integrally molding a main plate, the guide portion, and blades arranged between the main plate and the guide portion.

[0014] In this air conditioner, the centrifugal fan can be assembled simply without using any large-scale equipment. Accordingly, increases in the product cost can be avoided.

[0015] In an embodiment, the heat exchanger is formed into a rectangular frame shape surrounding periphery of the centrifugal fan.

[0016] According to this air conditioner, the air blow noise can be further reduced effectively.

[0017] Furthermore, the present invention provides an air conditioner comprising, within a casing, a cylindrical bell mouth for introducing room air, a centrifugal fan for radially blowing off air sucked in through the bell mouth, and a heat exchanger provided opposite to an air outlet of the centrifugal fan, wherein

> a shroud of the centrifugal fan has an annular guide portion which is provided radially outside the blade support portion and which abuts on an outer edge of the annular blade support portion to extend toward the suction side in the axial direction.

[0018] According to this air conditioner, air blow noise (foreign noise of around 800 Hz) is effectively reduced.

[0019] In an embodiment, the guide portion is curved so as to change in direction from one direction in which the outer edge of the blade support portion radially extends, toward the suction side in the axial direction.

[0020] According to this air conditioner, the air blow noise is reduced effectively.

[0021] In an embodiment, the guide portion bends so as to change in direction from one direction in which the outer edge of the blade support portion radially extends, toward the suction side in the axial direction.

[0022] According to this air conditioner, the air blow noise is reduced effectively.

[0023] In an embodiment, the guide portion extends to a specified extent in the same direction as the direction of the outer edge of the blade support portion, and bends at the place where the guide portion has extended to the specified extent.

[0024] According to this air conditioner, the air blow noise is reduced effectively.

[0025] In an embodiment, the guide portion extends from the outer edge of the blade support portion straight toward the suction side in the axial direction.

[0026] In an embodiment, the centrifugal fan is made up by engaging the blade support portion with a fan body which is formed by integrally molding a main plate, the guide portion, and blades arranged between the main plate and the guide portion.

[0027] In this air conditioner, the centrifugal fan can be assembled simply without using any large-scale equipment. Accordingly, increases in the product cost can be avoided.

[0028] In an embodiment, the heat exchanger is formed into a rectangular frame shape surrounding periphery of the centrifugal fan.

[0029] According to this air conditioner, the air blow noise can be further reduced effectively.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030]

> Fig. 1 is a longitudinal sectional view showing the construction of an air conditioner according to one embodiment of the present invention;
>
> Fig. 2 is a plan view showing main part of the air conditioner;
>
> Fig. 3 is a view showing the relationship between air flow rate and air blow noise of the air conditioner in comparison with a prior art example and the like;
>
> Fig. 4 is a view illustrating the construction of an air conditioner at the prior art;
>
> Figs. 5A and 5B are views showing an example in which a sub-shroud is welded and fitted to the fan body, where Fig. 5B shows the centrifugal fan as viewed from the suction side in the axial direction, and Fig. 5A shows a sectional view taken along the line A - A of Fig. 5B;
>
> Figs. 6A and 6B are views showing a first example in which the fan body and the sub-shroud are fitted by being engaged with each other, where Fig. 6B shows the centrifugal fan as viewed from the suction side in the axial direction, and Fig. 6A shows a sectional view taken along the line A - A of Fig. 6B;
>
> Figs. 7A and 7B are views showing a second example in which the fan body and the sub-shroud are fitted by being engaged with each other, where Fig. 7B shows the centrifugal fan as viewed from the suction side in the axial direction, and Fig. 7A shows a sectional view taken along the line A - A of Fig. 7B;
>
> Figs. 8A, 8B and 8C are views showing a third

example in which the fan body and the sub-shroud are fitted by being engaged with each other, where Fig. 8B shows the centrifugal fan as viewed from the suction side in the axial direction, Fig. 8A shows a sectional view taken along the line A - A of Fig. 8B, and Fig. 8C shows a sectional view taken along the line B - B of Fig. 8B; and

Figs. 9A, 9B, 9C and 9D are views showing modification examples, respectively, of the guide portion of the shroud of the centrifugal fan.

BEST MODE FOR CARRYING OUT THE INVENTION

[0031] Hereinbelow, embodiments of the air conditioner of the present invention are described in detail.

[0032] Fig. 1 shows a longitudinal sectional view of an air conditioner 1 according to an embodiment. This air conditioner 1 comprises, within a casing 2, a bell mouth 8 for introducing room air, a centrifugal fan 10 for radially blowing off air that has been sucked in through this bell mouth 8, and a heat exchanger 9 provided opposite to an air outlet 10b of the centrifugal fan 10.

[0033] In this example, the casing 2, which is housed in a ceiling pocket S through an opening H provided in a ceiling R, has, along the ceiling R, a dressing panel 20 including a suction grille 22 and a grille fitting frame 21. On the rear side of the dressing panel 20, is provided an inner frame 11 having a conical-surfaced inner peripheral surface 11a opened toward a casing top plate 2a and an outer peripheral surface 11b comprising four planes forming the four sides. In the top surface of the inner frame 11, is formed a receiving groove (drain groove) 12 comprising a flat bottom face 12b, an annular inner side face 12a extending along the inner peripheral surface 11a, and an outer side face 12c comprising four planes along the outer peripheral surface 11b.

[0034] The bell mouth 8 is formed into a cylindrical shape by boring a circular hole in the center of a partitioning plate 8b and besides curving the edge 8a of this circular hole toward the centrifugal fan 10. This bell mouth 8 is installed by fitting the partitioning plate 8b to an end portion of the inner frame 11 on the suction grille 22 side.

[0035] The centrifugal fan 10 has a main plate 4 placed along the casing top plate 2a, a shroud 5 opposed to the main plate 4, and a plurality of blades 6 provided between the main plate 4 and the shroud 5. In the center of the main plate 4, is provided a hub 4b of a truncated-cone shape curved toward the suction grille 22. A fan motor 3 is provided at a recess of the hub 4b on the casing top plate 2a side, and the main body of the fan motor 3 is mounted on the casing top plate 2a via an L-shaped flange 3b and a rubber isolator 17. Besides, an output shaft (rotary shaft) 3a of the fan motor 3 is fitted to a hole 4a of the hub 4b via a rubber isolator 16. The shroud 5 has an annular blade support portion 5b that makes contact with the blades 6. A cylindrical mouthpiece portion 5a curving and extending toward the suction side in the axial direction is integrally provided radially inside the blade support portion 5b. This mouthpiece portion 5a overlaps with the cylindrical portion 8a of the bell mouth 8 to surround the outside of the cylindrical portion 8a with a spacing. That is, the mouthpiece portion 5a forms a suction opening 10a of this centrifugal fan 10. Also, an annular guide portion 5c which curves and extends toward the suction side in the axial direction to approach the inner peripheral surface 11a of the inner frame 11 is integrally provided radially outside the blade support portion 5b. Guided by this guide portion 5c, the air blown off through the air outlet 10b of the centrifugal fan 10 smoothly passes through a gap 13 between the centrifugal fan 10 and the heat exchanger 9.

[0036] The heat exchanger 9, as shown in Fig. 2 (which shows a view of Fig. 1, excluding the dressing panel 20, the inner frame 11 and the bell mouth 8 in Fig. 1, as seen from below), is formed into a rectangular frame shape along the outer side face 12c of the receiving groove 12. As shown in Fig. 1, this heat exchanger 9 is placed so as to reach the casing top plate 2a from the bottom face 12b of the receiving groove 12.

[0037] In operation, the centrifugal fan 10 is rotated by the fan motor 3. As a result, room air is sucked to the centrifugal fan 10 through the suction grille 22, the bell mouth 8 and the suction opening 10a, and then radially blown off through the air outlet 10b by the blades 6 around the rotary shaft 3a. The blown-off air, while guided by the guide portion 5c of the shroud 5, passes through the gap 13 between the centrifugal fan 10 and the heat exchanger 9, undergoing heating or heat absorption by the heat exchanger 9. Then, the air passes through a gap 14 between the heat exchanger 9 and a casing side plate 2b, thus being blown off into the room through an air outlet 23 of the dressing panel 20.

[0038] Fig. 3 shows in one-dot chain line the relationship between air flow rate and air blow noise of the air conditioner 1 in this embodiment. For comparison's sake, data of a prior art example (one equipped with the fan guide 107 shown in Fig. 4) is shown in broken line, while data without any guide is shown in solid line. As can be understood from Fig. 3, the air conditioner 1 of this embodiment, in which the shroud 5 of the centrifugal fan 10 is equipped with the aforementioned guide portion 5c, showed that air blow noise can be reduced by about 2.0 - 2.5 dBA as compared with the prior art example, and by about 3 dBA as compared with the case without any guide.

[0039] Also, as shown in Fig. 2, since the heat exchanger 9 is formed into a rectangular frame shape surrounding the periphery of the centrifugal fan 10, not only a narrow-gap portion 13a but also a wide-gap corner portion 13c are generated as the gap 13 between the centrifugal fan 10 and the heat exchanger 9. This allows the air blow noise to be further reduced.

[0040] Further, since the guide portion 5c is formed integrally with the shroud 5, differing from the fan guide

107, material cost, transport cost and installation cost can be reduced so that the product cost can be reduced, as compared with the prior art example. In addition, as a matter of course, it is also possible to make the guide portion 5c independently of the blade support portion 5b, and assemble it later.

[0041] Still, it is also possible that the main plate 4, the blades 6 and the guide portion 5c, which are part of the components of the centrifugal fan 10, are integrally molded of resin (the molding is referred to as "fan body") while the mouthpiece portion 5a and the blade support portion 5b, which are the remaining components of the centrifugal fan 10, are integrally molded of resin (the molding is referred to as "sub-shroud"), and that the sub-shroud is fitted to this fan body.

[0042] Fig. 5A shows an example in which the sub-shroud 51 is fitted to such a fan body 50 in a direction of arrow C, and a side edge 6a of each blade 6 and the blade support portion 5b of the sub-shroud 51 are welded by using an ultrasonic bonding machine (not shown). In this example, as shown in Fig. 5B, a plurality of blades 6 are provided at equal angular intervals (45°) on the peripheral port of the main plate 4 (although eight blades are provided, only five are shown for simplicity, which is applicable also to Figs. 6 to 8). In Fig. 5B, hatched portions are the welded portions. In such a case, the shroud 5 may be composed of the guide portion 5c on the fan body 50 side and the sub-shroud 51 (the position after the fitting is shown in two-dot chain line).

[0043] However, when the sub-shroud 51 is fitted to the fan body 50 by welding with an ultrasonic bonding machine like this, equipment investment therefor and the number of working processes for welding would cause an increase in the cost of the air conditioner. Thus, with a view to avoiding the cost increase, the fan body 50 and the sub-shroud 51 may be installed by being engaged with each other as described below.

[0044] Figs. 6A and 6B show a first example in which the fan body 50 and the sub-shroud 51 are fitted by being engaged with each other. As shown in Fig. 6A, a rectangular through hole 61 is provided at the side edge 6a of each blade 6 on the fan body 50 side, while engaging claws 52, 53 and 54 are provided at the blade support portion 5b on the sub-shroud 51 side. As shown in Fig. 6B, the claws 52, 53 of the blade support portion 5b are provided at locations corresponding to the through holes 61 of the individual blades 6 in the state that the claws 52, 53 are paired back to back with a constant spacing. On the other hand, a plurality of claws 54 are placed on the outer edge of the blade support portion 5b at equal angular intervals (45°), more specifically, at intermediate angular positions of the blades 6, 6, ..., respectively. As can be seen from Fig. 6A, the claws 52, 53, 54 are equipped with inclined surfaces 52a, 53a, 54a, respectively, which are approximately 45° inclined with respect to the fitting direction C, and engaging surfaces 52b, 53b, 54b, respectively, which are adjacent to the inclined surfaces 52a, 53a, 54a, respectively, and vertical to the fitting direction C. In this example, when the sub-shroud 51 is made to approach the fan body 50 in the direction of arrow C, the inclined surfaces 52a, 53a of the claws 52, 53 come into contact with the periphery 61a of the through hole 61, so that the claws 52, 53 are flexed in such a direction as to approach each other. Then, after the inclined surfaces 52a, 53a of the claws 52, 53 have passed through the through hole 61, the claws 52, 53 are freed from the flexure, restoring to the original shape. Meanwhile, the inclined surface 54a of the claw 54 is brought into contact with the inner edge of the guide portion 5c so that the claw 54 is flexed radially inward. Then, after the inclined surface 54a of the claw 54 has passed through the inner edge of the guide portion 5c, the claw 54 is freed from the flexure, restoring to the original shape. As a result of this, the engaging surfaces 52b, 53b of the claws 52, 53 are engaged with the periphery 61a of the through hole 61 while the engaging surface 54b of the claw 54 is engaged with the inner edge of the guide portion 5c. In this way, by engaging the fan body 50 and the sub-shroud 51 with each other (the position after the fitting is shown in two-dot chain line), the shroud 5 can be made up easily. As a result, increases in the cost of the air conditioner can be avoided. Still, because pairs of claws 52, 53 and the claws 54 are arranged alternately with respect to the circumferential direction of the sub-shroud 51, a multiplicity of engaging points are presented with respect to the circumferential direction so that the fan body 50 and the sub-shroud 51 can be fitted firmly.

[0045] Figs. 7A and 7B show a second example in which the fan body 50 and the sub-shroud 51 are fitted by being engaged with each other. As shown in Fig. 7A, engaging claws 62, 63 are provided on the side edge 6a of each blade 6 on the fan body 50 side, and besides an engaging claw 56 is provided at the guide portion 5c. On the other hand, rectangular through holes 55 are provided in the blade support portion 5b on the sub-shroud 51 side. As shown in Fig. 7B, the claws 62, 63 of the blade side edge 6a are paired back to back with a constant spacing. A plurality of engaging claws 56 of the guide portion 5c are provided on the inner edge of the guide portion 5c at equal angular intervals (45°), more specifically, at intermediate angular positions of the blades 6, 6, ..., respectively. On the other hand, the through holes 55 in the blade support portion 5b are provided at locations corresponding to the pairs of the claws 62, 63 of the blades 6, respectively. As can be understood from Fig. 7A, the claws 62, 63, 56 are equipped with inclined surfaces 62a, 63a, 56a, respectively, which are approximately 45° inclined with respect to the fitting direction C, and engaging surfaces 62b, 63b, 56b, which are adjacent to the inclined surfaces 62a, 63a, 56a, respectively, and vertical to the fitting direction C. In this example, when the sub-shroud 51 is made to approach the fan body 50 in the direction of

arrow C, the inclined surfaces 62a, 63a of the claws 62, 63 come into contact with the periphery 55a of the through hole 55, so that the claws 62, 63 are flexed in such a direction as to approach each other. Then, after the inclined surfaces 62a, 63a of the claws 62, 63 have passed through the through hole 55, the claws 62, 63 are freed from the flexure, restoring to the original shape. Meanwhile, the inclined surface 56a of the claw 56 is brought into contact with the outer edge of the blade support portion 5b so that the claw 56 is flexed radially outward. Then, after the inclined surface 56a of the claw 56 has passed through the outer edge of the blade support portion 5b, the claw 56 is freed from the flexure, restoring to the original shape. As a result of this, the engaging surfaces 62a, 63a of the claws 62, 63 are engaged with the periphery 55a of the through hole 55 while the engaging surface 56b of the claw 56 is engaged with the outer edge of the blade support portion 5b. In this way, by engaging the fan body 50 and the sub-shroud 51 with each other (the position after the fitting is shown in two-dot chain line), the shroud 5 can be made up easily. As a result, increases in the cost of the air conditioner can be avoided. Still, because pairs of claws 62, 63 and the claws 56 are arranged alternately with respect to the circumferential direction of the fan body 50, a multiplicity of engaging points are presented with respect to the circumferential direction so that the fan body 50 and the sub-shroud 51 can be fitted firmly.

[0046] Figs. 8A, 8B and 8C show a third example in which the fan body 50 and the sub-shroud 51 are fitted by being engaged with each other. As shown in Fig. 8C, grooves 64, 65 each having a recessed shape in cross section are provided in blade surfaces 6b, 6c of each blade 6 on the fan body 50 side. Besides, engaging claws 57, 58 are provided in the blade support portion 5b on the sub-shroud 51 side. As shown in Fig. 8B, the engaging claws 57, 58 of the blade support portion 5b are provided at locations corresponding to the individual blades 6, respectively, so as to be opposed to each other. Also, on the outer edge of the blade support portion 5b, a plurality of claws 59 are provided at equal angular intervals (45°). More specifically, the claws 59 are placed at intermediate angular positions of the blades 6, 6, ..., respectively. As can be understood from Figs. 8A and 8C, the claws 57, 58, 59 are equipped with inclined surfaces 57a, 58a, 59a, respectively, which are approximately 45° inclined with respect to the fitting direction C, and engaging surfaces 57b, 58b, 59b, respectively, which are adjacent to the inclined surfaces 57a, 58a, 59a, respectively, and vertical to the fitting direction C. In this example, when the sub-shroud 51 is made to approach the fan body 50 in the direction of arrow C, the inclined surfaces 57a, 58a of the claws 57, 58 shown in Fig. 8C come into contact with both sides of the blade side edge 6a (edges between the side edge 6a and the blade surfaces 6b, 6c), so that the claws 57, 58 are flexed in such a direction as to separate away from each other. Then, ends of the claws 57, 58 slide on the blade surfaces 6b, 6c so as to be fitted into the grooves 64, 65, so that the claws 57, 58 are freed from the flexure, restoring to the original shape. Meanwhile, the inclined surface 59a of the claw 59 shown in Fig. 8A is brought into contact with the inner edge of the guide portion 5c so that the claw 59 is flexed radially inward. Then, after the inclined surface 59a of the claw 59 has passed through the inner edge of the guide portion 5c, the claw 59 is freed from the flexure, restoring to the original shape. As a result of this, the engaging surfaces 57b, 58b of the claws 57, 58 are engaged with side walls of the grooves 64, 65, respectively, while the engaging surface 59b of the claw 59 is engaged with the inner edge of the guide portion 5c. In this way, by engaging the fan body 50 and the sub-shroud 51 with each other (the position after the fitting is shown in two-dot chain line), the shroud 5 can be made up easily. As a result, increases in the cost of the air conditioner can be avoided. Still, because the pairs of claws 57, 58 and the claws 59 are arranged alternately with respect to the circumferential direction of the sub-shroud 51, a multiplicity of engaging points are presented with respect to the circumferential direction so that the fan body 50 and the sub-shroud 51 can be fitted firmly.

[0047] In addition, although the outer edge of the blade support portion 5b is to be closely fitted to the inner edge of the guide portion 5c in the examples of Figs. 6, 7 and 8, it is also possible that the outer edge of the blade support portion 5b is slightly overlapped with the inner edge of the guide portion 5c as in the example of Fig. 5.

[0048] Further, in the above examples, the guide portion 5c is curved so as to change in direction from one direction in which the outer edge of the blade support portion 5b radially extends, toward the suction side in the axial direction. However, this is not limitative. As shown in Figs. 9A, 9B and 9C, the guide portion 5c may turn so as to change in direction from one direction in which the outer edge of the blade support portion 5b radially extends, toward the suction side in the axial direction. In the example shown in Fig. 9A, the guide portion 5c bends at a place where the guide portion 5c has extended to a specified extent in the same direction as the direction of the outer edge of the blade support portion 5b, and once again bends at a place where the guide portion 5c has extended to another specified extent, thus changing in direction toward the suction side in the axial direction. In the example shown in Fig. 9B, the guide portion 5c extends to a specified extent in such a direction as to turn with respect to the guide portion 5c, and the guide portion 5c turns at the place where the guide portion 5c has extended to the specified extent, thus changing in direction toward the suction side in the axial direction. In the example shown in Fig. 9C, the guide portion 5c turns only once at a place where the guide portion 5c has extended to a specified extent in the same direction as the direction of the outer edge of the blade support portion 5b, thus changing in

direction toward the suction side in the axial direction. Also, as shown in Fig. 9D, the guide portion 5c may extend from the outer edge of the blade support portion 5b straight toward the suction side in the axial direction. As far as the guide portion 5c in abutment on the blade support portion 5b extends toward the suction side in the axial direction, air blow noise can be reduced, in any case, as compared with the prior art.

Claims

1. An air conditioner (1) comprising, within a casing (2), a cylindrical bell mouth (8) for introducing room air, a centrifugal fan (10) for radially blowing off air sucked in through the bell mouth (8), and a heat exchanger (9) provided opposite to an air outlet (10b) of the centrifugal fan (10), wherein

   a shroud (5) of the centrifugal fan (10) has an annular guide portion (5c) which is provided radially outside the annular blade support portion (5b) and which curves and extends toward a suction side in an axial direction.

2. The air conditioner according to Claim 1, wherein

   the centrifugal fan (10) is made up by engaging the blade support portion (5b) with a fan body (50) which is formed by integrally molding a main plate (4), the guide portion (5c), and blades (6) arranged between the main plate (4) and the guide portion (5c).

3. The air conditioner according to Claim 1 or 2, wherein

   the heat exchanger (9) is formed into a rectangular frame shape surrounding periphery of the centrifugal fan (10).

4. An air conditioner (1) comprising, within a casing (2), a cylindrical bell mouth (8) for introducing room air, a centrifugal fan (10) for radially blowing off air sucked in through the bell mouth (8), and a heat exchanger (9) provided opposite to an air outlet (10b) of the centrifugal fan (10), wherein

   a shroud (5) of the centrifugal fan (10) has an annular guide portion (5c) which is provided radially outside the blade support portion (5b) and which abuts on an outer edge of the annular blade support portion (5b) to extend toward the suction side in the axial direction.

5. The air conditioner according to Claim 4, wherein

   the guide portion (5c) is curved so as to change in direction from one direction in which the outer edge of the blade support portion (5b) radially extends, toward the suction side in the axial direction.

6. The air conditioner according to Claim 4, wherein

   the guide portion (5c) bends so as to change in direction from one direction in which the outer edge of the blade support portion (5b) radially extends, toward the suction side in the axial direction.

7. The air conditioner according to Claim 6, wherein

   the guide portion (5c) extends to a specified extent in the same direction as the direction of the outer edge of the blade support portion (5b), and bends at the place where the guide portion (5c) has extended to the specified extent.

8. The air conditioner according to Claim 4, wherein

   the guide portion (5c) extends from the outer edge of the blade support portion (5b) straight toward the suction side in the axial direction.

9. The air conditioner according to any one of Claims 4 to 8, wherein

   the centrifugal fan (10) is made up by engaging the blade support portion (5b) with a fan body (50) which is formed by integrally molding a main plate (4), the guide portion (5c), and blades (6) arranged between the main plate (4) and the guide portion (5c).

10. The air conditioner according to any one of Claims 4 to 9, wherein

    the heat exchanger (9) is formed into a rectangular frame shape surrounding periphery of the centrifugal fan (10).

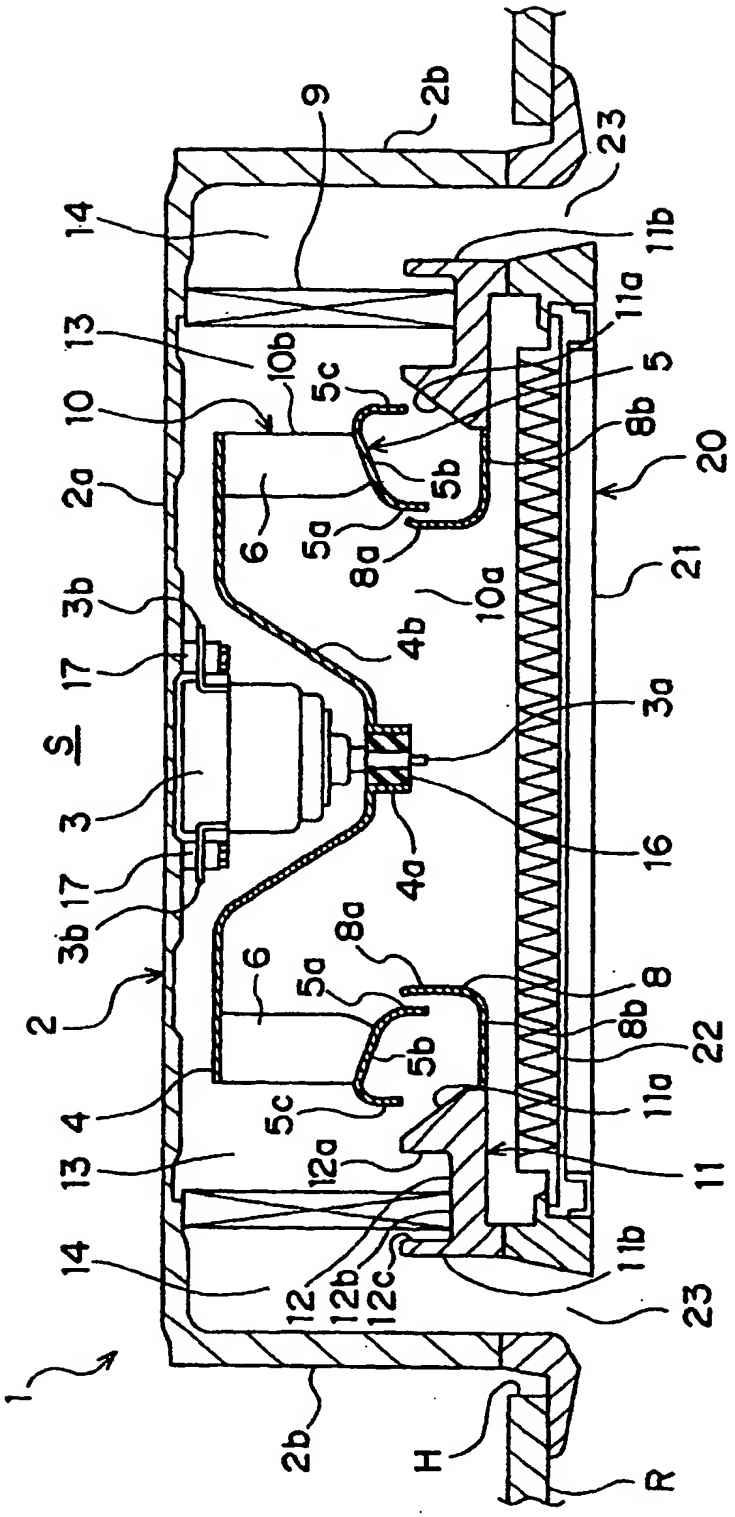


Fig. 1

Fig.2

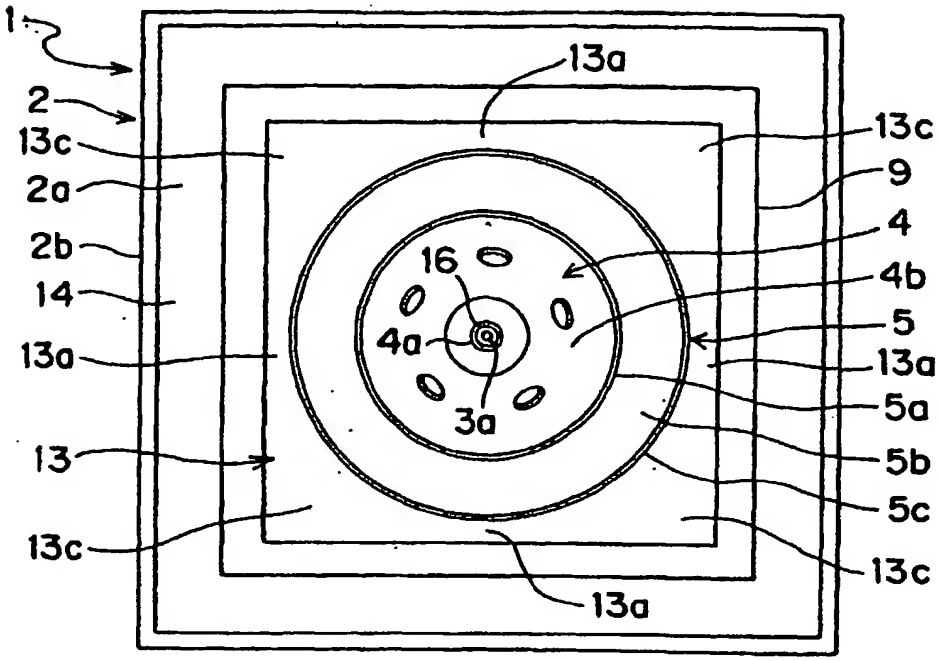
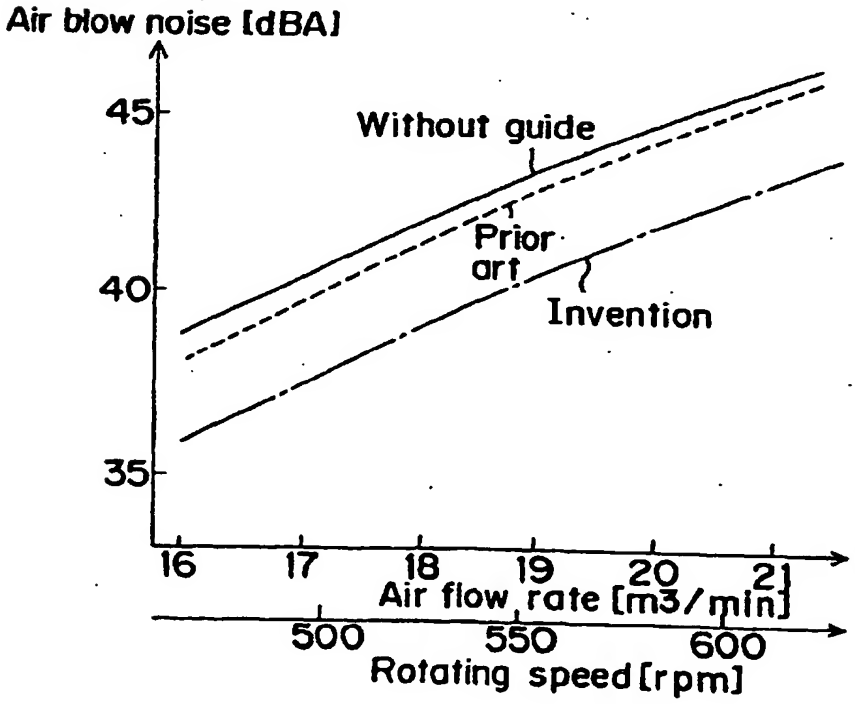


Fig.3



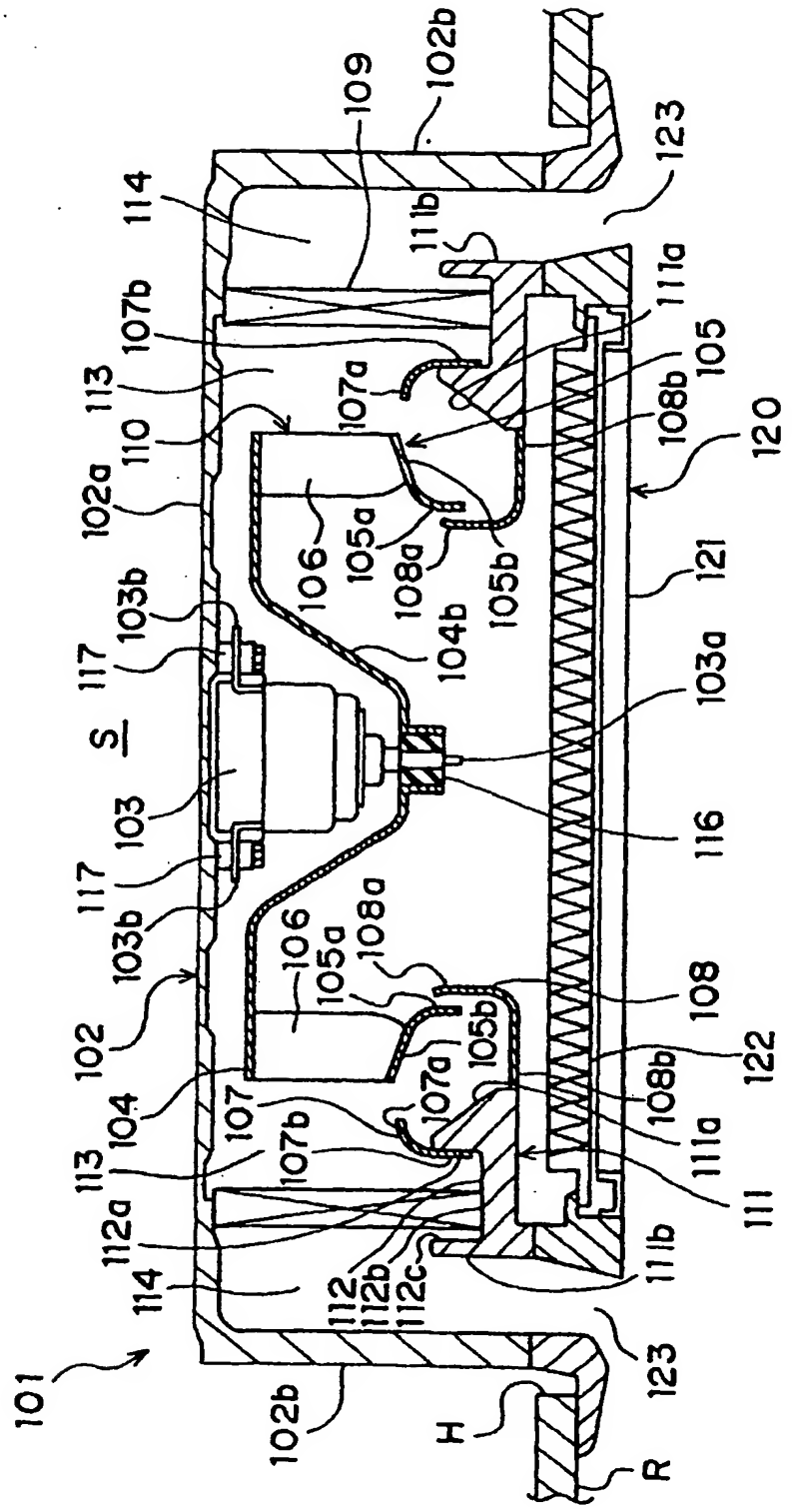


Fig. 4

Fig.5A

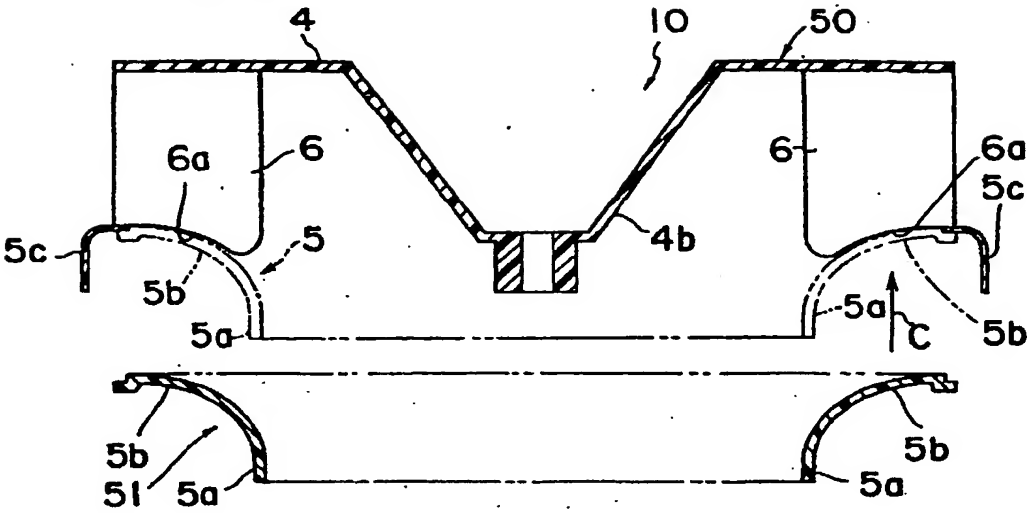


Fig.5B

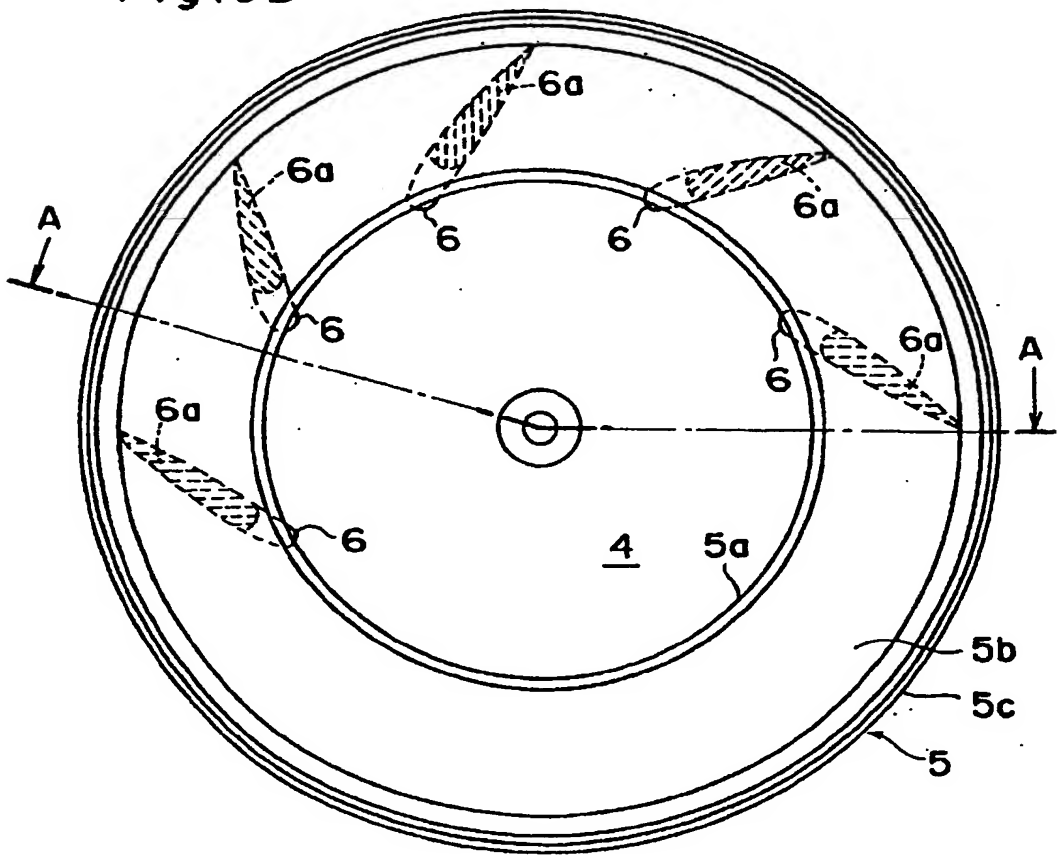


Fig. 6A

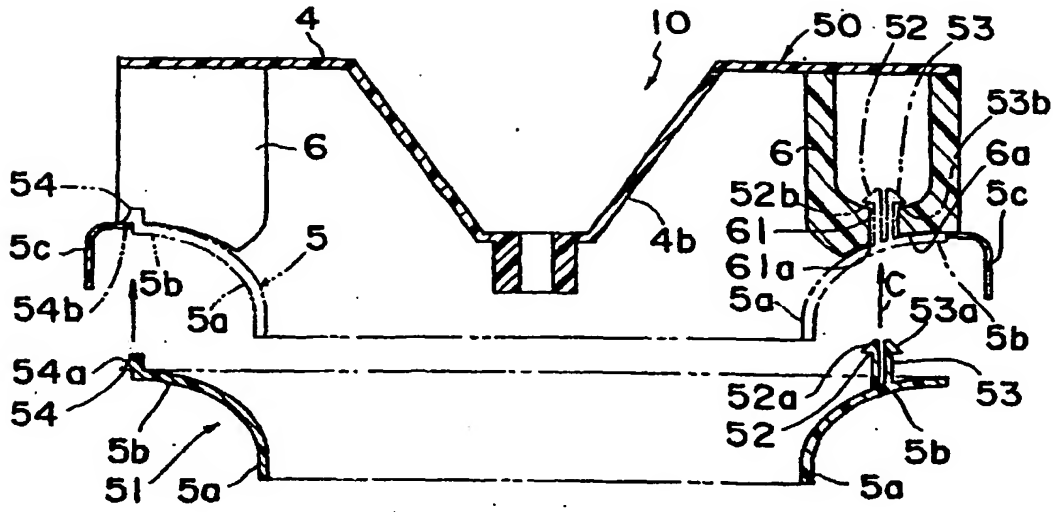


Fig. 6B

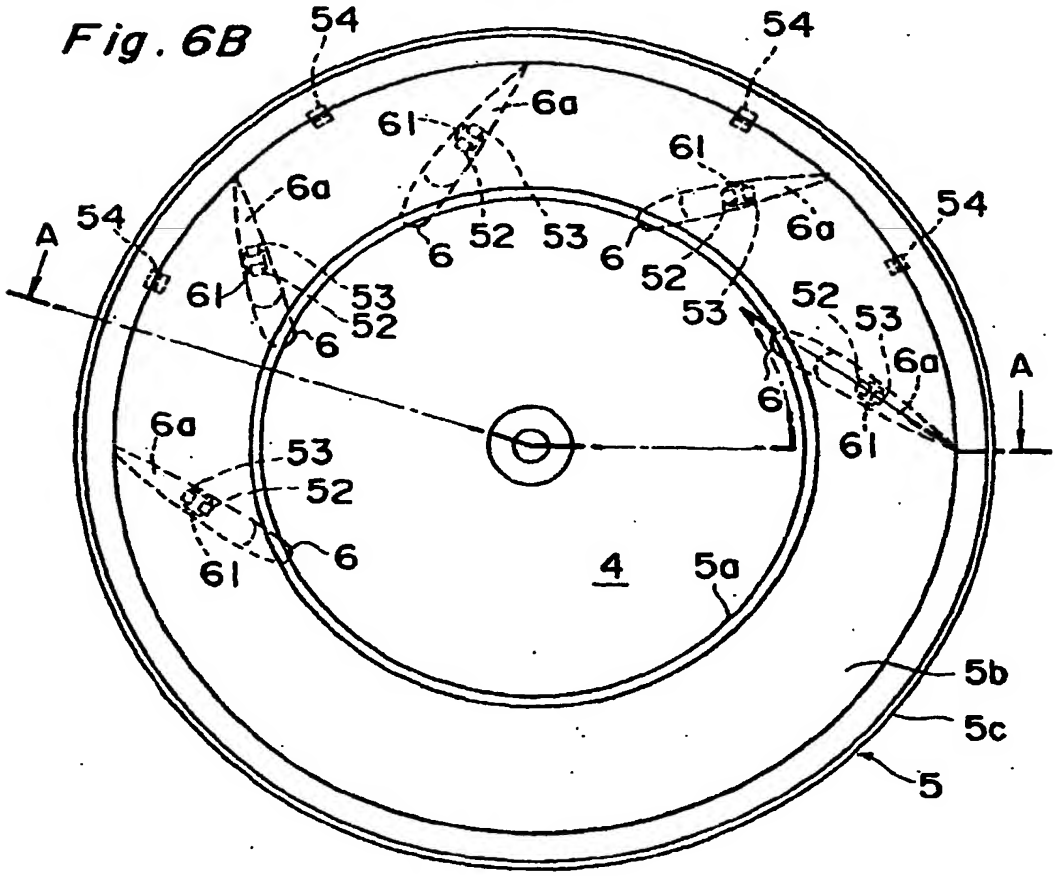


Fig. 7A

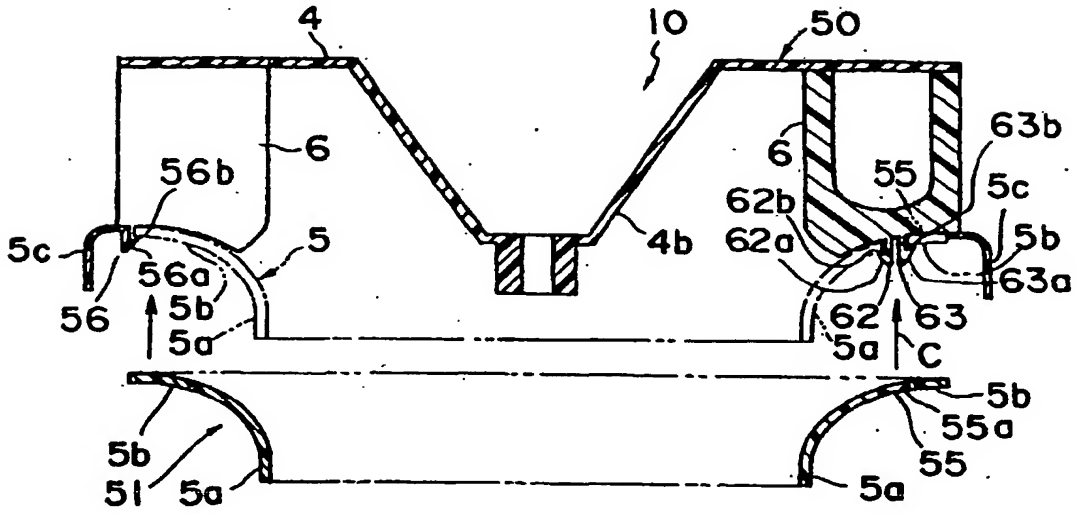


Fig. 7B

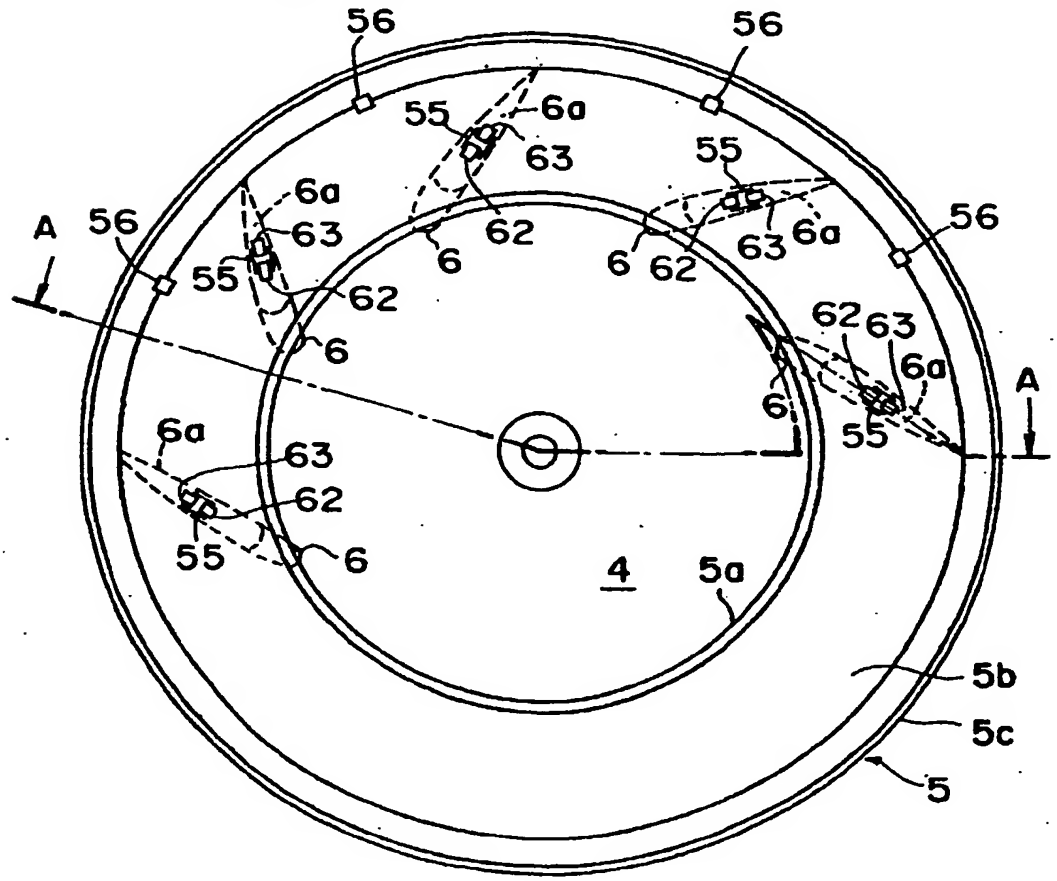


Fig. 8A

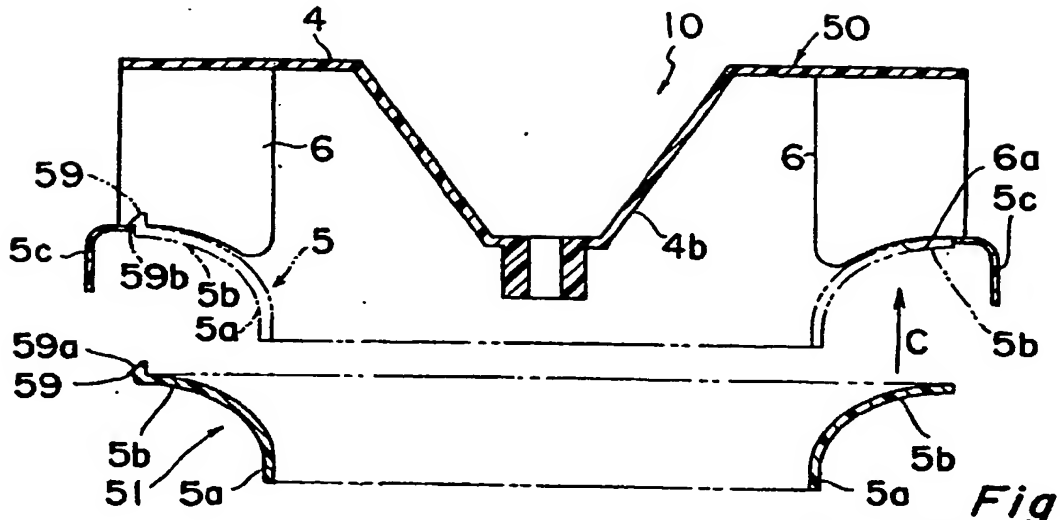


Fig. 8B

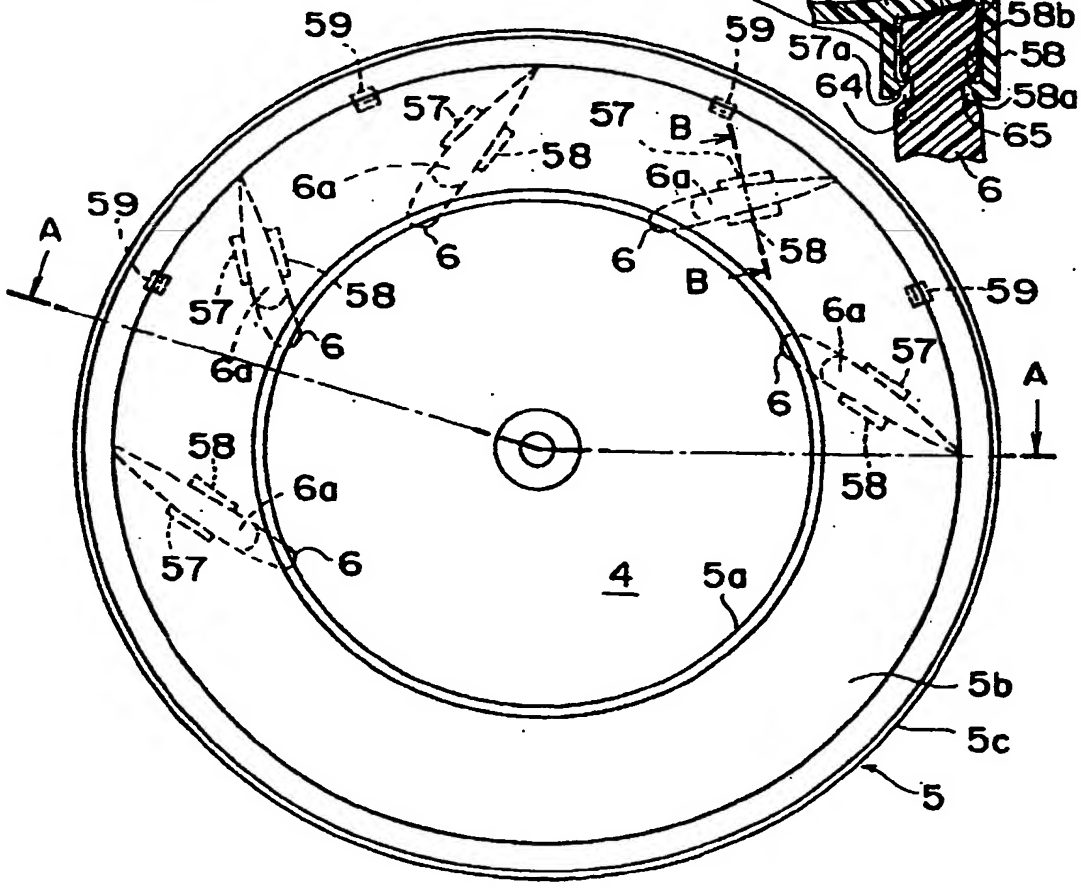


Fig. 8C

Fig.9A

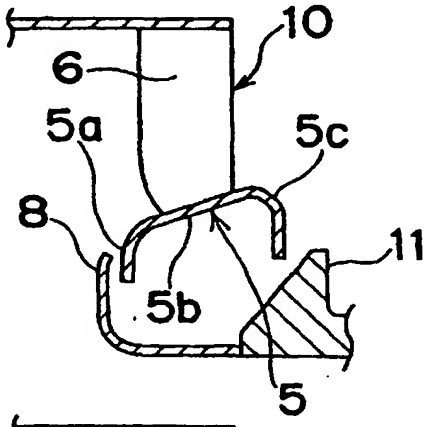


Fig.9B

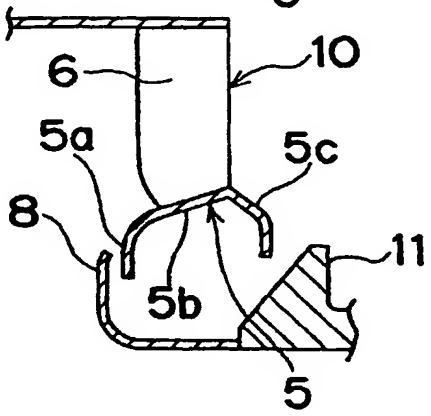


Fig.9C

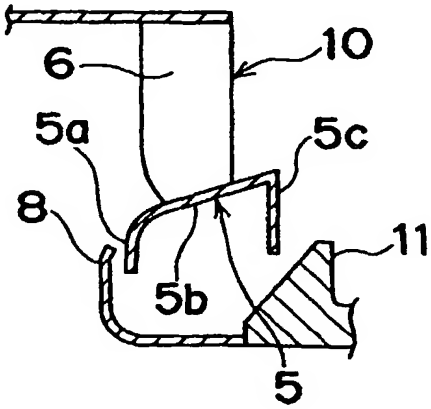
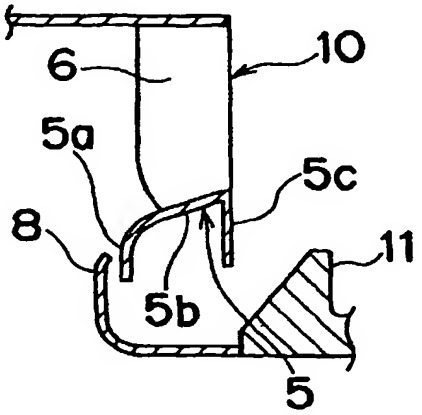


Fig.9D



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP98/02638

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] F24F1/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[6] F24F1/00, F04D29/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1998 Toroku Jitsuyo Shinan Koho 1994-1998
Kokai Jitsuyo Shinan Koho 1971-1998

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 2-166323, A (Daikin Industries, Ltd.), 27 June, 1990 (27. 06. 90) (Family: none)	1, 4-8
A	JP, 4-263717, A (Mitsubishi Heavy Industries, Ltd.), 18 September, 1992 (18. 09. 92) (Family: none)	1, 4-8
A	JP, 5-172361, A (Daikin Industries, Ltd.), 9 July, 1993 (09. 07. 93) (Family: none)	3, 10

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 September, 1998 (08. 09. 98)	22 September, 1998 (22. 09. 98)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)